A report to the Environment Agency & SAA

The use of fencing to prevent access by otters to fisheries.

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Introduction from Chris Burt, SAA

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Introduction from SAA (Specialist Anglers Alliance)

The return of the otter has had one sad consequence for anglers, for it was not foreseen that they would include specimen fish amongst their prey, particularly large carp in winter. Fishery managers should be aware of the dangers of otter predation and consider the practicality of protecting their fisheries by applying our research findings.

Considerable advice is available to establish whether it is otters that are causing problems to a fishery, and if so whether compromise measures such as decoy ponds etc might be sufficient. However, it is not the remit of this document to advise on all the measures you can take; this study is for those who have decided to take the ultimate steps against otter predation, and install protective fencing. Expensive, yes, but the only sure defence!

In order to best protect our waters we needed to establish what was the most cost effective fencing to keep otters out of specimen still-water carp fisheries. The Environment Agency has funded this research (commissioned from Forest Research and The Otter Consultancy) and this is now presented in our report.

The proposed fencing is as unobtrusive as possible, with variations designed to suit different situations and soil types. Comprehensive tests were conducted at an otter sanctuary using different fencing materials, and the researchers also studied the practicalities of installation.

SAA would like to encourage feedback and interaction from those owners protecting their fisheries, and to that end do please email us at otters@saauk.org to discuss your queries and findings. This report will be regularly updated as our understanding of the issues evolves, and displayed on both SAA' website www.saauk,org, and the EA website www.environment-agency.gov.uk.. Most importantly, EA Fisheries Officers, EA Conservation Officers, and The Wildlife Trusts Water for Wildlife Project Officers are all available to offer practical advice and help by visiting your fishery, and are contactable through SAA or the EA and The Wildlife Trusts addresses at the end of this report.

Fencing does offer the most suitable means of protection against otter predation, particularly for still-water fisheries. Establishing the effectiveness and costs of various fencing types will be used to continue our search for funding for individual and national schemes.

SAA is indebted to the EA for the funding to conduct this research, and to the commitment and professionalism of Forest Research, The Otter Consultancy, and the New Forest Otter, Owl & Wildlife Conservation Park.

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Summary of recommendations.

- We present a decision tree for fisheries managers on the approach to fencing against otters.
- We describe some typical fence specifications and the appropriate materials.
- Existing fence specifications would gain from incorporating best practice, especially on the use of high tensile line wire instead of mild steel, and attention to detail on spacing of any electric wire.
- We would encourage formal monitoring of fences and reporting back of the degree of effectiveness of protection systems to Fisheries Officers Wildlife Trusts Officers or SAA.
- Forest Research is encouraging final development of remote fence alarms that phone the fisheries manager when there is a problem with an electric fence.

1. Introduction.

As otters increase their range to cover many parts of the UK, their activities are increasingly coming into conflict with angling interests. These range from fish farms to still water angling where specimen fish are very vulnerable, especially in the winter months.

Otters travel extensively and will follow very small streams or ditches and cross open land in search of feeding sites. As a consequence, most fisheries are potentially vulnerable to otter predation.

Because adult otters are able to go through holes of 100mm diameter and can climb over and dig under fences, a standard fence (e.g. sheep netting, weld mesh or chicken mesh) will not usually act as a barrier to otters.

Meetings between SAA, EA and Defra, determined that whilst the fishing community was pleased to support the increase in otter distribution, there was an increasing need for the provision of advice and to reduce future damage to stocks. The use of fencing would be appropriate but Defra appeared not at that stage to be prepared to assist in partial funding. A number of waters currently fence against otters, using a variety of fence specifications. The specifications for differing situations need clarification.

Fencing trials with captive otters, and using a number of different designs and materials, were carried out at the New Forest Otter, Owl & Wildlife Conservation Park at Ashurst near Southampton. The trials were to establish specification options for the fencing, to cope with different situations of soil type, tree cover, the presence of livestock etc.

2. Objective,

The objective of this report is to provide advice on the design specifications of otter proof fencing for fisheries that are appropriate for a range of different situations.
To achieve this, two actions were undertaken.

1. A review of fencing already in use against otter predation,
2. Trials against captive otters of a range of fence designs as otter barriers.

3. Methods.

3.1. A review of fencing already in use against otter predation.

A simple collation of different fence designs was undertaken by visiting different sites in East Anglia, Devon, Cornwall and South Hampshire together with viewing pictures from other locations.

3.2. Trials against captive otters of a range of fence designs as otter barriers.

Fencing trials with captive otters, using a variety of fence specifications were carried out at the New Forest Otter, Owl & Wildlife Conservation Park at Ashurst, near Southampton, Hampshire. Figure 1.

The small numbers of otters used were the property and responsibility of the Conservation Park; only those specifications approved by them were allowed to be tested. Some options we wished to trial were not allowed. The site manager carefully monitored the welfare of the otters used in the trials.

3.2.1 Test pen

During winter 2003 a special pen was built as part of ongoing construction at the Conservation Park. It consisted of two typical holding pens of c. 12m square bounded by the normal ‘dug in chain link with steel sheet overhangs and outrigger electric wires’ but having a gap of 1.8m in the joint fence. During late spring 2004 a fixed frame of Dexion was inserted into this gap. Side pads of sheet steel and electrified wires were installed at a high level to prevent escape should any otter get on top of the frame. At the base a railway sleeper was fixed on top of the buried chain link net so digging under the frame was not an option. A second, removable frame that could be easily fixed into position in the gap was constructed so that different materials and shapes could be created as testing panels.
On either side of the fence panel the pen contained two nest boxes, piles of logs and a pond.

3.2.2 Trials objective

There were three areas to investigate;

1. Maximum mesh size to prevent otter access.
2. Effectiveness of an overhang at the top of the fence.
3. Effectiveness of an electrified wire with mesh fencing.

3.2.3 Methodology of trial.

The form of each trial was as follows.

- An otter was placed in the pen and allowed to establish itself throughout the twin enclosure.
- A panel of the chosen specification was constructed on the removable frame and bolted in place.
- Food was placed twice daily on both sides of the frame.
- A video camera was set up covering the experimental panel. Tape speed was set to cover the daytime and twilight activity of a 24-hour period on a single tape.
- Minor changes to fences were made as required on reviewing the tape.

An individual fence trial had 2-12 days of tape evidence from an individual otter.

3.2.4 Trials undertaken .

Three otters were used, a small female [termed almost a runt and the smallest adult the Conservation Park had kept] and two males. All trials for one otter were completed before being replaced by the next.

1. 50mm hexagonal chicken mesh 1.2m height.
2. Hexagonal rabbit netting 1.2m height,
3. 75mm square woven [stock type] net.
4. Short rabbit netting 90cm height.
5. 1.2m rabbit net with overhang of 30cm at 45 degrees [as per the HA roadside specification].
6. 0.9m fence with e-wire 75mm offset from the top. The voltage was adjusted to 3.5KV to represent the minimum that often occurs in the field.

4. Results.

4.1. Fences already in use.

A variety of fence designs have been used by fisheries owners in a range of different situations round the UK. Construction details (or composites of several similar forms) are shown in Table 1. Most of these have been in place for a number of years and owners report they have been successful in preventing otter access.

Table 1. Fences seen or details supplied.

	Netting used; finished fence height	**Base of fence**	**Fence wire support; stake type**	**Top construction**
1	Green chainlink; 1.5m.	Buried 30cm.	Mild steel wire; Wood posts @2.5m.	600mm rabbit net overhang
2	Galv Rabbit net; 0.75m.	Buried 30cm	Wood strips; thin wooden @3m	1 e-wire @ 75mm above top
3	Galv EU reinforced rabbit net; 0.9m	Lapped 150	Mild steel; stout wooden@ 4m.	Top and central e-wire
4	Galv chicken net 1.2m. wide; Height 0.9m	Buried ? 30cm lap as separate piece of netting	Mild steel; stout wood posts. Second set of stakes	Overhang 600mm chicken net on second set of stakes. e-wires at base and below overhang
5	50mm galv welded net ; 1.5m	Buried 60cm	None, sawn wood posts	300 angled overhang+ barbed wire
6	Galv chicken netting 0.9m	Buried ?25cm.	None; wood stakes @ 6m with 2 thin droppers between	Bottom, centre and top offset electric wires.
7	Electrified rabbit net. 0.7m polythene with fine electrified wires	Bottom non-electrified polythene strand on ground	Plastic integral stakes	Wires electrified; lengths clip together.
8	Chain link or welded mesh 1.8m	Vertically buried 60cm	Mild steel; Wood stakes at 2 metres	Solid steel sheet 60-75cm centred across top stakes. Sometimes e-wire at edge.
9	1.2 m rabbit net, 0.9m finished height	Buried 15 and turned 15cm	None; wood stakes @ 2m	e-wires at 50 and 90cm
10	*Electric wires, Polywire, Braided wire or High tensile*	*10-12cm above ground and parallel multiples*	*Very variable because of site contour changes. Hard to keep gaps consistent*	*Reportedly up to 4 parallel strands*

4.1.1 Comments on existing fences

A wide variety of fences appeared to succeed. The comments below are designed to increase cost effectiveness and indicate where best practice can be incorporated in the future.

- Most current fencing has mesh with holes unnecessarily small. Chain link mesh must not be the lightweight version.
- The spacing of stakes on most sites was unnecessarily close. The use of a high tensile [or spring steel] line wire for the top of a fence allows for wider stake spacing every 10/11 metres is sufficient. Note however that high tensile wire demands firm straining posts at every change in direction of the fence line, which can be achieved in soft ground by the use of box strainer assemblies, i.e. 2 posts set approximately 2m apart with a wood stake fixed between them at the top and a strained wire diagonally fixed at ground level at the corner post. It can be expensive for irregular boundary shapes or uneven ground however. Installation is generally considered to require skilled overseeing but local volunteer labour can often help.
- Otters can climb, so a fence of 1 metre or 1.5 metres or 0.9 metres can be crossed if the otter is determined to do so [we have had rabbits crossing over a 3 metre rabbit fence!]. At 0.9 metres a dog otter can reach to the top without using the front paws to climb.
- The mesh should be on the side of the stakes TOWARDS the otter pressure. It is critical that if burying netting vertically the backfill is placed on the inside of the fence, squashing the net onto the hard face of the trench See fig 6E. If an underground lap is required, the backfill can only be placed on the outside, where the otter can dig easily. See Fig 6F.
- To prevent the fence being climbed, an additional out-turn of fencing is used, or an e-wire.
- An electric wire slightly offset out and down from the top of a mesh fence will be better protected from branches than one directly on top of the fence. The use of [adjustable] plastic cable-ties placed inside 50mm lengths of water pipe can be used to keep a standard space between the electric and main fence wires – reducing the incidence of shorting or overlarge gaps.
- Electric fencing using ‘rabbit’ net has several implications. Remove rabbit e-net if not required during the spring/summer so it is not eaten by rabbits/hares etc. Provision of a sprayed strip of herbicide is necessary to reduce shorting. NB green electrified rabbit net is now available.
- While we heard about the use of ‘stand-alone’ single or multiple parallel strand electric fences we did not see this used or receive a specification with an endorsement of its efficacy

4.2. Pen fence trial results.

Fifteen different trials were completed. A total of 81 videotapes were taken and analysed for different behaviours at the fence. On five occasions the tape was accidentally not set to record or malfunctioned.

a. fence mesh size.

We tested 31mm hexagonal rabbit netting, 50mm hexagonal chicken net and 75mm square tightlock. Figure 2

Key result: No otters passed through any of the three meshes tested.

A small quantity of pushing or pulling activity was recorded and use of the paws to reach through the mesh towards the food. No otter tried to seriously bite through the 50mm chicken wire, which was only 1mm thick. The small female was able to put her head through the 75mm square mesh but not to get a shoulder through. Fig 2. The males could not get more than the muzzle through. Good rabbit net is c.1.2mm diameter, which is tougher and lasts longer than the normal chicken net of 1.0mm. The rectangular mesh is 2.0mm high tensile steel and will last several times longer than the others but will be more expensive because all netting is related to the price of steel. Note rabbit netting will undoubtedly not last as long as more robust netting, but no figures on its life expectancy are available at the tile of going to press

b. fence height [0.9 and 1.2m] and presence of overhang (Figure 3a).

Key result: All otters put paws on the fence, 1 otter climbed all fences.

All otters initiated activity to get over by putting paws up the fence [70 occasions recorded] or standing on the hind legs looking up [30 occasions]. Short climbs and climbing almost to the top were recorded 45 times. One otter did not climb any fence during 4 days. One climbed over the 0.9m fence on the second day but not the 1.2m fence. Only Otter 3 climbed all fences, including the 30cm overhang on the first day of each trial, and crossed back and forth at will.

Editors note; Although not included in these test results, it should be noted that the Otter Sanctuary itself uses a 1.2m high fence, with a horizontal out-turn of 450mm of tin sheeting, coupled with an e-wire placed at the end of the out-turn. This however is very expensive, and it should be born in mind that this is designed to cope with captive otters, which are far more used to evading these means of containment.

Key point**: **At other waters the use of a 1.2m high fence and an angled 45cm out-turn has proved completely effective. SAA would welcome feedback on this.

c. inclusion of electrified wire, (Figure 3b).

Key result: All otters were deterred for at least 1 day. One otter climbed the fences repeatedly.

All otters received shocks from the e-wire, which had been set to be at 3.5Kv during pulses. Two otters repeatedly stood on their hind legs [27 times] or made a short climb [21 times] but each were observed receiving at least 2 shocks and failed to make a serious attempt to cross over. Otter 3 also stood on its hind legs and/or stretched up with its paws. It was difficult to determine how many shocks were received by this otter because of the visibility at the very start of the first trial but it did not climb over in the first day. This is significant because it had been recorded climbing over fences a total of 81 times in the previous 17 days. Climbing over by this otter subsequently occurred regularly [7 times a day], even though the fence voltage was checked as operating. These occurrences were despite the otter occasionally having been seen swimming minutes previously to climbing over. After an intervening trial with another fence design an e-wire was again tested; the otter was deterred for one day before repeatedly climbing over.

Editors note: It may be that these results of an otter climbing a live e-wire would not be replicated with wild otters, and that an e-wire may be completely effective. We would be most interested in gaining feedback to SAA.

Limitations of pen trials.

We did not have the resources to test all versions of fencing against all otters. Once mesh size and strength was determined those trials ceased. As the trials progressed, scavenging birds took more and more food before the test otter could reach it. This made it difficult to be certain that otters had not crossed during darkness. Despite creating a 150mm high caged area with a narrow entrance to place the dead fish or chicks under, corvids continued to steal the food. Otter 3 appeared very determined to eat all his food from both sides of the fence and had no hesitation in attempting to cross all fences provided. Only the electrified wire stopped his passage, during separated trials, and each only for 1 day.The electric voltage of 3.5KV was deliberately set to emulate a poorly maintained fence or fence under strain of shorting by vegetation. It still prevented otters from passing when they first encountered it. The main pen voltage [9.9Kv] was deliberately not transferred to the test fence as it is unlikely that field use of fencing can reliably deliver more than 5Kv. The energiser had only a normal slow pulse rate, a fast rate may have been more successful.

Wild otters may be much less used to crossing fences than captive animals and might be more cautious in attempting to cross, especially in the presence of an electric wire, but we have no empirical data to measure any difference.

5. Conclusions.

5.1 Fences already in use at fisheries.

A number of conclusions can be drawn from the designs used currently to increase cost effectiveness.

1. Create a strong base. Otters can dig in soft ground and where it has been made up – e.g. at dams etc. If burying a fence base any trenched material must be returned on the inside of the netting. An e-wire near the base will discourage digging. Lapping on the surface has been used against rabbits and foxes. Lapping 30-60cm of mesh is much cheaper than digging trenches unless a netting plough machine is used. See figure 11.
2. Netting. Neither otters nor stock can penetrate high tensile mesh of 75mm square. The cheapest chicken nets contain too thin wire –only 1.1mm diameter or greater should be used. Good rabbit net is acceptable. Welded mesh is over strong and usually has unnecessarily small openings and is hard to handle.
3. Electric ‘rabbit’ netting can be excellent as a temporary measure but has the drawbacks of easily being earthed by leaves, growing vegetation and other debris. If the power fails the fence will fail completely, but there are alarm systems in development. The energiser/battery must be connected to orange electric rabbit netting the day it is erected to prevent damage or passage by otters. If an individual learn to cross [when the fence is not electrified] an electric fence become almost useless. Electric sheep netting with larger holes is not suitable.

4. Stakes. A high tensile top line wire gives support to netting and allows stakes to be placed at 10 metres apart, saving on timber.
5. Top overhang. Horizontal metal sheet is the optimal option but expensive and unsightly except for captive pens. Metal rods, or bent flat bands or angle iron used to support mesh horizontally or at 45 degrees (Figure 4a and b). Alternative of a second set of supporting stakes is more expensive but stronger in branch prone areas. An e-wire may be placed under the supporting line wire. See Fig.7.
6. Electric wires offset from a mesh fence appears an attractive option for permanent fencing. Attention to detail on spacing of live wire[s] away from the growing vegetation and the distance from the fence itself is critical, along with keeping any e-wire some distance [e.g. 30cm] above the ground. See fig 6. Remember though that e-wire(s) require regular maintenance against shorting out by vegetation, this is a significant commitment and should not be underestimated.

5.2 Trials with captive otters.

1. Meshes of 50mm hexagonal and 75mm square appear to prevent otters accessing through the mesh. The use of 100mm 'hexagonal sheep' fence is too large.
2. Otter 3 was, from his history, an escapologist and has in the past seriously attempted to breach the wildlife park's pens by climbing trees and jumping, and climbing under the metal overhang.
3. The electric voltage of 3.5KV prevented otters from passing. Use of a fast repeat pulse setting may further support its field use.
4. The overhang was successful against 2 otters but otter 3 climbed it on the first day after 11 increasingly confident approaches.
5. A determined otter repeatedly returning to a site where it has already crossed a mesh fence will be harder to prevent with a new e-wire than if the e-wire was included initially.

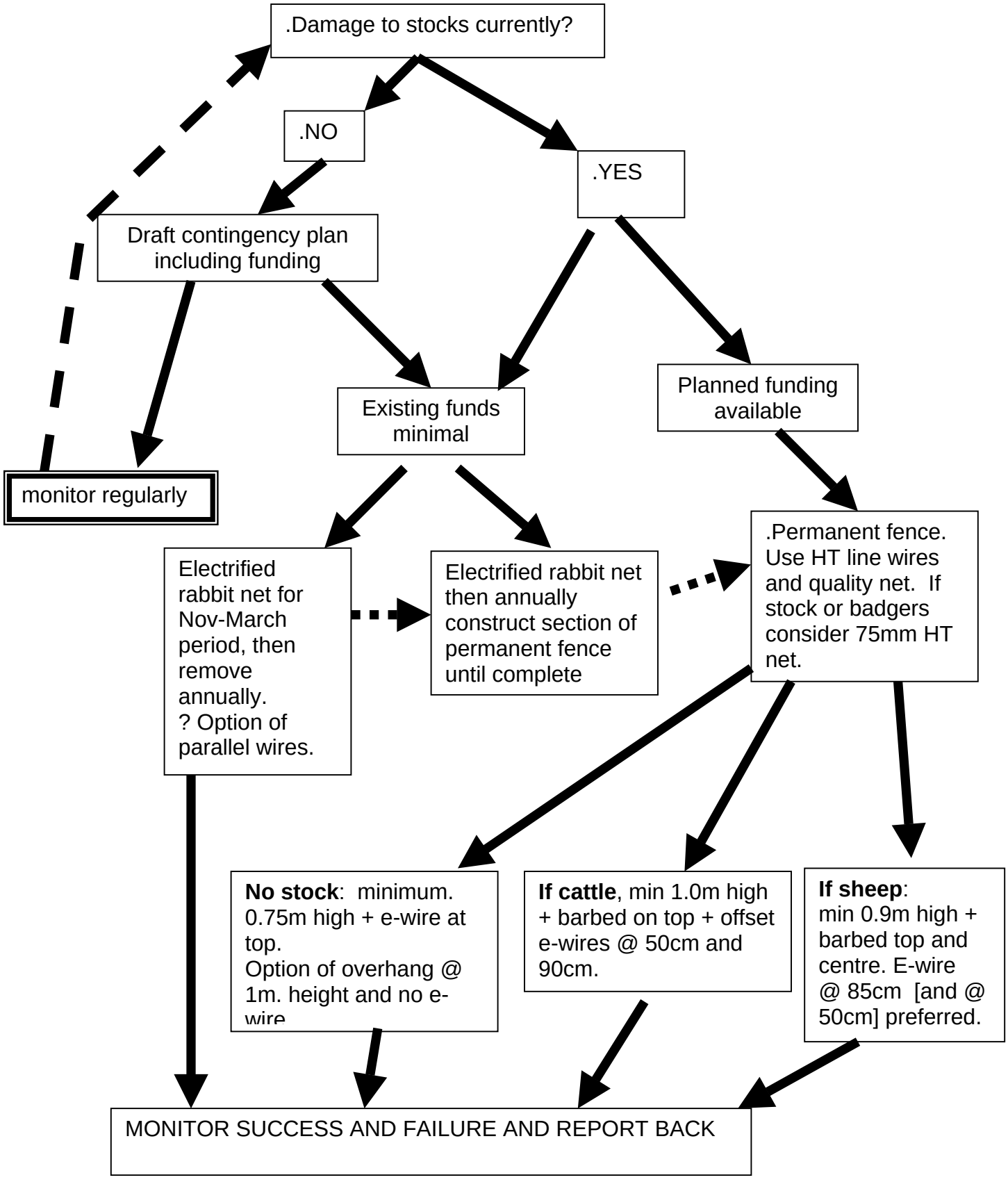
6. Preventing otter access to fisheries.

6.1 When to take action: Decision making.

A. Water keepers need to determine the answers to several questions.

1. Does the area have otters nearby now or likely to have otters in the near future?
2. Is it acceptable to put up temporary netting during the winter season only and take it down for the rest of the year?
3. Is a long term solution or whole year protection required now?
4. Does the site already have some form of fence that could be modified?

The following flow chart may be helpful.



The answer will determine the choice of barrier to keep otters out.

NB. Different parts of the fence my need to have slightly different specifications to account for very local conditions – e.g. wooded stretches, field boundaries with stock, aesthetically sensitive areas.

6.2 Issues to consider when deciding on the type of fence to use.

B. How close to habitation is the water? Electric fences can be operated by mains electricity units and the current carried 500 metres to the site – sometimes more.

C. Is any fencing entirely in the open [with few trees around] entirely in woodland, or with a few trees that might lose branches in winter gales? The presence of stock will influence the physical strength and form needed.

D. How often could you arrange maintenance inspections during the 'critical times'? Automatic telephone alarm systems are under development but probably not available yet as standard packages.

E. How much can be afforded for the fence now or in the future? Obviously this relates to the perimeter length required as well as the costs per metre for materials and for labour. Chain link, 75mm lock-knot rectangular mesh and welded mesh contain more metal, last much longer but are more expensive than rabbit or chicken wire or electric netting. High tensile line wires allow fewer stakes to be used but is harder to erect. Any electrified component will need an energiser, and probably a battery and solar/wind charger.

F. How hard is the ground? Digging trenches is expensive and putting the soil back after sliding in the net creates a soft strip for the otter to dig out again! Made up ground such as dams, outlets etc will usually be softer than the main perimeter and need more width to a lapped base.

6.2.1 Positioning the fenceline

The position of a fence can influence the capital cost, the cost of fence maintenance and the ease of removal of intruding animals. Unless along a legal boundary, it may be possible to make worthwhile savings by straightening out the line to eliminate one or more corner posts even at the expense of excluding some land. Factors that should also be considered when choosing the proposed fence line include:

- The visual impact that the fence may have immediately in the landscape or for amenity can be influenced by the chosen route. Growth of vegetation may reduce the visibility of the fence in due course, but will it need to be managed to prevent it becoming easier for otters to climb over or to prevent the fence being pulled over in high winds. An alternative style may be less intrusive – so long as it keeps otters out.

- The suitability of the terrain; the desirability to divert the line to avoid archaeological features and waterlogged soils. Situations which may require extra time to be allocated for construction include ease of digging-in and firming straining posts, steepness of slope and shallow soils over rock where it may be more difficult to prevent the bottom of the fence lifting.
- The impact of fencing on sites important for nature conservation, e.g. SSSI's. In the medium to long term removal of grazing (of stock and deer or rabbits) may significantly alter the vegetation composition and form.
- Ease of access for maintenance (vehicle gate) and the location and type of access points necessary for the fishermen/public.
- Minimisation of the number of times a fence line has to cross ditches and to reduce damage and maintenance requirements, particularly after heavy rainfall. A group of 75mm pipes or a 75mm grill may suffice.
- If the fence is to be sited across a watercourse or within a flood plain, Environment Agency consent may be required. Contact your local office for advice (appendix 4).
- Avoid fencing across established major wildlife pathways. A local wildlife expert can determine established badger paths and whether fencing will change their pattern of behaviour or result in additional pressure on the fence. It is likely that otters will penetrate badger gates.
- Avoidance of siting the fence where raised ground – or even a tree stump etc. is close to the outside of the fence which may assist otters jumping in.
- Taking account of the local climatic conditions, e.g. a valley prone to drifting snow. Moving the fence line some metres up or down a hillside can reduce the occasions when the fence will fail due to the weight of snow or allowing animals to cross on snow bridges.

6.3. Advice on fences.

1. Gates.
   a. Don't make the gate the weakest point! Note a heavy timber or concrete block positioned below the gate will stop otters digging through at this potential weak point.

b. A “Box section” to support the gate will help to withstand heavy usage; see Fig 10 (note photo does NOT include any measures to stop otters climbing here, these must be added too)

2. Outflow.

The use of in-lake outflow pipes is much safer than trying to fence stream outlets against otters. If stream outlets are needed, use welded mesh panels with a 75mm mesh across the stream in the fence line. Create a separate mesh dam or balloon within the lake to keep most flotsam away from the mesh.

3. Contact your local Environment Agency office for advice whether consent is needed to fence across culvert inflows or outflows.

6.3.1 Stand-alone electric fences:

- For any electric fence option, consider energisers in the order of mains; wind/solar; carrying batteries. This is because solar panels are less effective in winter [when the greatest otter pressure may occur]. Only for very large lakes where many miles of e-wires are needed will powerful energisers be needed – read the literature. It is important to use energisers that have a fast pulse rate option. Otters can move quickly and we want them to be stung before they attempt to cross, not when they are nearly over!
- Locate fence energisers inside the fence so that vandalism options are reduced. Vandal proof boxes [i.e. live] are available, de-energised by a key Figure 5a,b.
- Electric fences are only as good as the earth, follow the manufacturers instructions. If the earth rod is in moist soil all year that is the best option. On sandy dry sites a bottom line-wire of the fence will assist.
- Plastic electrified netting, if only used in winter, will not suffer from vegetation growth but will fail if too many leaves/twigs build up after wind – e.g. in a wood. So netting is less practical in this situation than parallel wires.
- Parallel wires [I would suggest at least 4 but have no experimental data] must all be live and be kept absolutely parallel, so use sticky tape or cable ties to keep them together.
- Use live wires for all lines, the animal is heavy enough to give an earth.
- Ensure that at least 5Kv is registered on the fence…most energisers will initially give at least 7Kv but its surprising how it leaks away.
- Warning signs on an electric fence are obligatory.
- Never attach it to or near an overhead electricity pylon…ask for advice
- Electrifying barbed wire is illegal.

6.3.2 Wire mesh fences.

See Figure 6 a-e.

- A high tensile top line wire gives support to netting and allows stakes to be placed at 10-12 metres apart on flat ground, saving on timber.
- Corner and straining posts must be properly dug in and braced or create a box style with two posts driven in. [See Fig 10, and see BTCV guide at;

http://handbooks.btcv.org.uk/handbooks/index/book/109 on fencing for details]. Gates must be hung on posts that are NOT strainers.

- Hiring a tractor [or small digger] with a mounted post rammer is a very worthwhile investment for larger lengths of fencing where access is possible.
- Do NOT use mild steel for line wires – it stretches and causes problems of the fence wobbling about, especially if there is an e-wire component of the fence.
- Mesh can be galvanised hexagonal rabbit net (31mm mesh) galvanised hexagonal chicken net (50mm mesh) or high tensile 'locked joint' net of maximum 75mm square mesh.
- Use of a lapped base is easier, quicker and cheaper than trenching (Figure 6a, b and c). 1.05m or 1.2m metal net can be lapped on the ground by 20-30cm [towards the otters] instead of buried, and then pegged down.
- A vertical fence can be constructed and then chicken wire of 30cm-60cm [purchased separately or slit a closed roll of wider material in half by careful use of an angle grinder] can be placed partly on the ground as an apron and lapped up the fence and clipped using a 'ring gun' to the bottom line wire (Figure 6b,c). On soft ground such as dams or silty areas the lapped base should be wider – perhaps a metre.
- Strimming the vegetation before construction will encourage regrowth. Vegetation will soon grow through the base mesh – some grass seed may help but take care in conservation locations.
- Vertical mesh should be supported by at least 2 line wires of High tensile (top and base), and extra barbed wires if sheep or cattle are likely to need to be contained by the fence.
- Wooden rails are not necessary to support the top of a fence but may be preferred aesthetically.

6.3.3 Overhang fences

These may be preferred in high-pressure situations. It requires an extra line wire at the outer edge, at least 1metre above ground, (Figure 6 d and e).
Overhang fences are not reliable in the presence of cattle.

- An overhang of 45cm is suggested if no electric wire is used, 30cm with an e-wire.
- If a self-supporting cantilever is chosen, use bent metal or a drilled in rod, not 'tile batten' for the overhang.
- The alternative, where there are no sheep, is a second set of stakes c. 40cm away from the main fence joined together by high tensile wire stapled into the tops. This is the strongest option in woodland or where top damage is expected. Some [e.g. 1/2] of these stakes can be plastic sink waste pipe or tile batten or thin steel pipe resting on the lapped base mesh. Put a separate length of galvanised chicken mesh on the top and fix to the line wires. A small angled cut 75mm from the top of a plastic stake can be used to locate an e wire [braided wire or 2.0 HT] if needed.

6.3.4 Use of mesh fence together with electric scare wire[s].

- The principle is that an electric wire should be placed so that the otter has to grab it to pull itself to the top. For a short vertical fence this should be set out less than 50mm towards the otter (and 50mm below the top wire to provide some protection from falling branches. Plastic cable ties inside 50mm lengths of hosepipe can be

used for a hanging e-wire (Figure 8). Screw in or nailed insulators are available (Figure 9).

- For a tall fence [e.g. where stock are present], a second e-wire may be positioned at least 30cm from the ground - to reduce the degree of shorting on vegetation - and if possible 15cm in front of the vertical mesh.
- If an electric wire is used, the fencing mesh may be of lighter gauge than otherwise – except where sheep/cattle will be present.
- The use of 'cotton reel' straining reels greatly assists maintenance. Any top e-wire should have insulated tensioners located at joins to preserve tension.
- Refer to manufacturers guides for gates – don't make them the weakest point!
- Use 150-200mm plastic cable ties [adjustable if possible] with 50mm hosepipe spacers to both keep a set distance [50mm] between the fence and the electric wire and prevent shorting.
- If the e-wire can be protected by the top line wire of the fence that will reduce shorting if the fence is damaged by small branches.
- Nothing can stop vandalism or a major tree falling reducing the fence efficiency.

6.3.5 Fence Maintenance.

Maintenance is a key operation; a walk round with simple tools/spares is essential after any gale.

- Removing the most obvious overhanging branches before winter may prevent the fence being severely damaged.
- To check that the wire is "live" and that the fence is operating at, a fence tester at c. £20 is recommended, which will also show the Kv being produced.
- We are trying to encourage development of an off-the shelf remote alarm pager for electric fencing.

7. Reference:

1. Agate. E. (2002) A guide to fencing. BTCV.
For details see http://handbooks.btcv.org.uk/handbooks/index/book/109
2. Trout R.C. & Pepper H.W. (2005) Forest fencing – best practice. Forestry Commission. [in press]

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Our thanks also to Graham Roberts, The Wildlife Trusts South East Otters & Rivers Project officer.

Chris Burt, SAA provided evidence of some of the currently used fence specifications and considerable encouragement.

Appendix 1. Woodwork for otter fences with other animals present.

Recommended woodwork for permanent fences and maximum spacing of stakes [length in metres (m) and top diameter in centimetres (cm.)]

Otter and other species	Endposts & turning posts m. x cm*	Struts m. x cm	Intermediate stakes m. x cm	Max. stake spacing m.
Rabbit/hare	2.0 x 10 -13	2.0 x 8 –10	1.7 x 5 - 8	10 -14
Rabbit + stock	2.3 x 10 -13	2.0 x 8 –10	1.7 x 8 -10	8
Sheep	2.3 x 10 -13	2.0 x 8 –10	1.7 x 8 -10	12
Cattle, quarry/ mines	2.3 x 10-13	2.5 x 10-13	1.8 x 8-10	6

Line wires should be 2.65mm spring steel or 3.15 high tensile steel. Special cutters and wire strainers should be used. See Agate 2000 for practical details.

Appendix 2. electric fences components and construction.

Components

There are six components that form an electric fence system.

1. The energiser produces a pulsed electric current, which is directed along the fence wires. Many have high and low output voltage settings. For safety, they should produce up to 5 joules of energy output at 500 ohms but not more. They may be powered either by mains supply or battery. Batteries have to be regularly recharged, or connected to a wind generator or solar panel via a non switching voltage regulator to prevent overcharging. ‘Leisure’ or deep-cycle marine batteries are recommended because they are more suitable than tractor or car batteries to withstand the fluctuating and often low state of charge.
2. An earthing rod assembly is an essential requirement to return the electrical pulse of energy to the fence unit. It consists of one or more copper covered or galvanised steel rods driven into the ground and firmly clamped to [not just wound round] the return wire of the energiser. In very dry soils a tensioned line wire

placed on the ground along the fenceline [e.g. holding down a lapped fence] and pegged or covered with turves every 50m will assist in the earthing process.

3. Fence supports may be wood, metal, plastic, or fibreglass. Some proprietary forms have built-in fixed or adjustable insulators. We recommend gaps of c. 80mm between parallel e-wires. Wooden stakes with strong insulators are needed where tensioned HT wires are used in an undulating site.
4. Insulators are a fundamental component, ensuring the pulsed current is not lost to earth but maintained to provide a high voltage shock [recommended at 4KV or above] to any animal touching the fence. There are many forms and types available suitable for particular situations but in the otter context the gap between the e-wire and the mesh fence needs to be kept c. 50-75mm to prevent an otter going between them and using the insulating properties of the fur.
5. Conducting wires may be of single or multi-strand steel wires or plastic string or tape containing fine stainless steel wires. All electrical connections should use proprietary joining clamps. Barbed wire must never be electrified. Wires may be tensioned by proprietary strainers appropriate to the line wire material and the end fixers (hard 'egg-shaped' types) used. Electrified plastic netting should only be used against sheep, rabbits and foxes; Deer and some other wild animals eg hedgehogs may get entangled as they react to a shock.
6. A fence tester is essential during maintenance to show whether the fence is providing sufficient voltage. Reliance solely on a fence 'flasher' unit is not recommended. Use of 150mm of green grass or twig provides only a crude indicator if the fence is working. The inclusion of some isolating switches can save time during maintenance.
7. Refer to manufactures catalogues and guides for materials.

Suppliers of electric fencing and their websites

AEC:	hotline-fencing.co.uk
Bramley & Wellesley:	bramley.co.uk
Gallagher Power fence:	gallagher.co.uk
Rutland:	rutland-electric-fencing.co.uk,
Rappa:	rappa.co.uk

Constructing Electric Fences

Four aspects are critical.

1. Any length of electric fencing is constructed and made live (including the earthing arrangement) the same day to ensure any animal touching the fence always receives a shock. A further section can be completed and electrified each day. Animals may continue to cross an electrified fence if it was not electrified when first encountered.
2. Adequate tension must be provided to prevent a 'dead short' through energised wires touching the ground [or shorting onto a mesh fence] which will damage the equipment and render the fence inoperative. Do not create a closed loop by actually joining the ends of the fence together because it will also damage the equipment.
3. Monitoring should ensure the fence remains live and is not allowed to be without power for any period; there are alarm systems to warn of failure under development.
4. Regular maintenance and inspection, not only to check the voltage but also the integrity of the fenceline posts [for example line fence contour posts across valleys may have pulled up, windblow resulting in fallen branches]. Broken insulators must also be replaced.

Other points to consider include:

- High tensile or braided steel line wires and plastic rope or tape can be tensioned with cotton reel or ratchet type strainers.
- If an animal is jumping forward it may continue through the fence through inertia and be trapped inside. Earthing through the ground, the metal mesh fence is the best option because it ensures any shock passes though the animal's thorax.
- Corner posts and intermediate straining posts require sturdy multiple insulator locations. Plastic and fibreglass stakes are self insulating, some have adjustable fittings. Insultimber is a special [but costly] hardwood that is self insulating
- Both the fence and power source must be removed immediately the need for it stops.

Appendix 3. Alternative fence designs recommended.

Options Remember otters can jump and climb so thought is needed in the location of all fences and potential jump points etc.	**Advantages** Cheapness now may not equal effectiveness long term.	**Disadvantages** Remember stock can stampede through fences and rub against them.	**Main items required** Costs relate to size of area involved, thickness of mesh material and other factors.
Electrified plastic Super rabbit netting	Quick, easy and relatively cheap to erect, quite effective in the short term. Could be used for 3 months each year then removed	Temporary, visually unattractive; critical need of a regular power supply, vegetation spraying and fence maintenance to ensure effectiveness. Can be dangerous to other wildlife. Do not use with cattle	Energiser, battery, charging unit [solar/wind/mains], rolls of e-netting. Vandal proof box, fence tester. Warning signs
Stand alone electric line wire barrier, double, triple quadruple parallel wires etc. Optimum distance above ground is 10-12cm and similar gaps. **Consultants unsure if this works**	Effective, easy to negotiate, less visually obtrusive. Good for small stew ponds or ornamental garden ponds (also effective around small fishery sites). Can use rabbit or chicken premade plastic posts between wood strainers	Can be awkward to erect and maintain tension and gaps in rough ground. Vegetation growth control needed. Polywire cheap but not permanent and hard to prevent sagging over long distances and in wind. Do not use with cattle [except dairy herd] without higher wires.	Endposts, energiser, battery and charging unit [solar/wind/mains] Multiple line wires and tensioners, insulators Vandal proof box fence tester Warning signs.
Permanent mesh fencing (not electrified). Post and wire with 1200 wide roll mesh (incorporating lapped base). Minimum 0.9 fence height	Cheaper to maintain than electric. Easier to lap (30cm).than trench [can use linewire at edge .	Peg down lap tightly with bent wire. Wider lap needed in soft places. Some otters may learn to climb over.	Endposts, stakes, linewires, quality galvanised mesh.
Permanent mesh fencing (not electrified). Post and wire with mesh (incorporating out-turned top and lapped base).	Cheaper to maintain than electric. Overhang more difficult for otter to climb.	Expensive to construct. (45cm overhang in high pressure locations). Needs second roll of [thin] material for overhang. Relatively fragile against woodland/tree debris	Endposts, stakes, linewires, quality galvanised mesh. Separate roll of top net and overhang metalwork
Mesh fencing with electrified offset top wire. Post and wire with mesh. Top e-wire offset 50mm and below top of fence	May be used on top of 0.75m fence, preferably offset from 0.9m fence. E-wire protected from light branches etc by main fence line wire. Linewire holding down lap can be used as extra earthwire.	Initial cost of materials and instalment. Maintenance of ongoing power supply and fence line, Can cause offence or obstruction to people and other wildlife.	Endposts, stakes, linewires, quality galvanised mesh. Energiser, battery, charging unit [solar/wind/mains], line wires, tensioner, insulators, vandal proof box, fence tester Warning signs.
Mesh fence with electrified extra top and midline wire. Post and wire with chicken mesh .top e-wire offset 50mm and below top of fence. Second e-wire 50cm above ground	Used on 2 fences above. E-wire protected from light branches etc by main fence line wire. Linewire holding down lap can be used as extra earthwire. May be used with stock.	Initial cost of materials and instalment. Maintenance of ongoing power supply and fence line, Can cause offence or obstruction to people and other wildlife. Use unelectrified barbed wire as top of fence if stock present.	Endposts, stakes, linewires, galvanised mesh. Energiser, battery, charging unit [solar/wind/mains], line wires, tensioner, insulators, vandal proof box, fence tester Warning signs.

1. For all permanent electric fencing use a 2.5 mm high tensile wire [or braided wire for small lengths]. Energiser with fast pulse option. Solar/wind power sources with a voltage regulator in line with a 'leisure' battery of c. 100Ah.

2. Fencing materials should be sourced from good agricultural suppliers or manufacturers.

ENVIRONMENT AGENCY

To contact any Region of the EA in England and Wales simply phone 08708 506506

Note. EA Fisheries Officers, EA Conservation Officers, and The Wildlife Trusts Water for Wildlife Project Officers are available to offer practical advice and help by visiting your fishery, and are contactable through the EA and The Wildlife Trusts addresses shown here. The most suitable contact can vary between these two organisations for any given area, so we would strongly suggest contact is made with both organisations initially. This will ensure the best possible response is obtained for constructive advice etc. The Wildlife Trusts in particular can also help confirm whether it is otters that are causing problems with your fishery.

SAA

In case of difficulties with contacts however, please contact Chris Burt of SAA PO Box 8988 Chelmsford CM1 6UZ
Email otters@saauk.org

THE wildlife TRUSTS

Wildlife Trusts
For list of Wetland Officer contacts see table on following page

Wildlife Trust	Telephone	Town	E-mail	Wildlife Trust	Telephone	Town	E-mail
Avon	0117 917 7270	Bristol	rachelsharp@avonwildlifetrust.org.uk	Lincolnshire	01507 526 667	Horncastle	csteel@lincstrust.co.uk
Beds, Cambs, Northants & P'boro	01604 405 285	Northampton	terry.smithson@wildlifebcnp.org	London	020 7261 0447	SE1	lwells@wildlondon.org.uk
Beds, Cambs, Northants & P'boro	01234 362 774	Bedford	graham.bellamy@wildlifebcnp.org	Montgomeryshire	01938 555654	Welshpool	cfaulkner@montwt.cix.co.uk
Beds, Cambs, Northants & P'boro	01954 713 513	Cambridge	chris.gerrard@wildlifebcnp.org	Norfolk	01603 625 540	Norwich	steveh@norfolkwildlifetrust.org.uk
Berks, Bucks and Oxfordshire	01865 775476	Oxford	hannahgraves@bbowt.cix.co.uk	North Wales	01248 351 541	Bangor	ChrisWynne@wildlifetrustswales.org
Birmingham & the Black Country	0121 454 1199	Birmingham	chris.p@bbcwildlife.org.uk	Northumberland	0191 284 6884	Newcastle Upon Tyne	kevin.ohara@northwt.org.uk
Brecknock	01874 625 708	Brecon	cmorgan@brecknockwt.cix.co.uk	Nottinghamshire	0115 958 8242	Nottingham	jbradley@nottswt.cix.co.uk
Cheshire	01270 610 180	Nantwich	ebarratt@cheshirewt.cix.co.uk	Radnorshire	01597 823 298	Llandrindod Wells	jonesj@radnorshirewildlifetrust.org.uk
Cornwall	01872 240777 x 214	Truro	kate@cornwt.demon.co.uk	Scottish	0131 312 7765	Edinburgh	lschneidau@swt.org.uk
Cumbria	01539 816 304	Kendal	davidh@cumbriawildlifetrust.org.uk	Sheffield	0114 263 4335	Sheffield	l.shaw@wildsheffield.com
Derbyshire	01773 881188	Belper	pprecey@derbyshirewt.co.uk	Shropshire	01743 284 280	Shrewsbury	janmckelvey@shropshirewt.cix.co.uk
Devon	01392 279 244	Exeter	pmoore@devonwt.cix.co.uk	Somerset	01823 652400	Wellington	david.westbrook@somersetwildlife.org
Dorset	01305 264620/21 7972	Dorchester	bbruce@dorsetwt.cix.co.uk	South and West Wales	01656 724100	Mid Glamorgan	dyfrig@waterforwildlife.fsnet.co.uk
Durham	01915 843 112	Houghton le Spring	tcoult@durhamwt.co.uk	Staffordshire	01889 880100	Sandon	nmott@staffswt.cix.co.uk
Essex	01621 862 960	Colchester	joc@essexwt.org.uk	Suffolk	01473 890089	Ashbocking	pennyhemphill@suffolkonline.net
Gloucester	01452 383 333	Gloucester	colins@glucswt.cix.co.uk	Surrey	01483 488055	Woking	cmatcham@surwild.cix.co.uk
Gwent	01600 740358	Church Street	srogers@gwentwildlife.cix.co.uk	Sussex	01323 870810	Nr Polegate	fsouthgate@southeastwater.co.uk
Hampshire and Isle of Wight	01489 774400	Curbridge	grahamr@hwt.org.uk	Tees Valley	01642 759900	Redcar	jgarside@teesvalleywt.cix.co.uk
Herefordshire	01432 356 872	Tupsley	fgriffith@herefordwt.cix.co.uk	Ulster	02844 830 282	Crossgar	heather.thompson@ulsterwildlifetrust.org
Hertfordshire and Middlesex	01727 858 901	St Albans	alison.washbrook@hmwt.org	Warwickshire	02476 302 912	Coventry	sophie.lloyd@wkwt.org.uk
Kent	01622 662 012	Maidstone	richard.moyse@kentwildlife.org.uk	Wiltshire	01380 725 670	Devizes	marks@wiltshirewildlife.org
Lancs, Manchester & Nth Merseyside	01772 324 129	Preston	tmitcham@lancswt.cix.co.uk	Worcestershire	01905 754919	Hindlip	andyg@worcswt.cix.co.uk
Leicester and Rutland	0116 272 0444	Oadby	chill@lrwt.org.uk	Yorkshire	0113 278 1724	Leeds	yorksotters@cix.co.uk